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UNIVERSITY OF KANSAS.

BULLETIN

OF THE

DEPARTMENT OF ENTOMOLOGY.

The More Destructive Grasshoppers of Kansas.

Snow, Francis Huntington

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A BULLETIN

ON

DESTRUCTIVE GRASSHOPPERS OF KANSAS.

Grasshoppers as pests are well known in Kansas. Here the effects of their ravages have been fully demonstrated. While such a general devastation as took place in the '70s may never occur again, local destruction of crops is sure to take place at times unless well-directed means of prevention are used.

Since all grasshoppers (or locusts) subsist upon vegetation, all are injurious. Some species, however, possess peculiar characteristics or are favored by special conditions, making their numbers greater; consequently the damage is more noticeable. Of this class the present paper will treat.

From various localities in the state the department has received complaints concerning destruction by grasshoppers. A letter from Mr. Geo. W. Watson, Kinsley, Kan., was referred to us by the secretary of the State Board of Agriculture. After considerable correspondence with Mr. Watson, we thought it advisable to visit that locality and take observations upon existing conditions. Accordingly the junior member of the department left for Edwards county on September 29. The department is greatly indebted to Hon. Jno. E. Frost, land commissioner of the Atchison, Topeka & Santa Fe railway, for favors of transportation upon this and other trips for similar purposes.

On the morning of the 30th, Mr. R. E. Edwards, president of the Kinsley Bank, took us to a large tract of alfalfa southwest of Kinsley. There are about 400 acres of alfalfa in this piece, all the property of Mr. Edwards. Here we found a few of the Rocky Mountain Locust, but many more of what is known as the Differential Locust, or *Mel-*

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anoplus differentialis. The farmers speak of them as "those big yellow fellows." Mr. Edwards stated that the grasshoppers had not been so injurious in that tract as farther west. Yet wherever the alfalfa was young and tender from recent sowing nothing appeared above ground but stubble. Where the plants were older and tougher the damage was not so noticeable. In the afternoon and the next forenoon we visited a number of alfalfa fields, and found conditions much the same as upon the first day.

In the afternoon of the 30th, Hon. A. C. Dyer, county attorney for Edwards county, took us to a locality west of Kinsley where the damage had been great. Here the small Rocky Mountain Locust was more abundant, with a goodly number of the two-striped *Melanoplus bivitattus*, but, as before, the Differential Locust was by far the more abundant. Adjacent to one piece of alfalfa there had been a piece of corn which they entered after the alfalfa had been cut and completely stripped it, killing it before tassels had appeared.

It was not, however, for the purpose of observing the amount of damage done that the visit was made so much as to note existing conditions. These will be discussed farther on under the head of "Alfalfa and the Grasshoppers." Here we will say that everywhere we were glad to observe that of the Differential Locust (*M. differentialis*) there were apparently as many dead as alive to be seen. Natural enemies were at work, but too late to be of any assistance in preserving this year's crop, though certainly of benefit in curtailing the number of eggs which would hatch to destroy next year's growth. In many cases the cause for death was apparently the work of a fly which deposits its eggs upon the back of the grasshopper. The larvæ—small, whitish, worm-like creatures, or maggots—soon find their way into the interior of the grasshopper and produce the death of the insect. These larvæ were found in a number of the specimens taken, and later two of them changed in the laboratory to adults. They proved to be flesh-flies, (*Sarcophogo* sp.) Many of the 'hoppers had been deprived of one or both wings—the work of the locust mite.

Grasshoppers belong to the order of insects known as Orthoptera or straight-winged insects, such as the cricket, katydid, and praying horse. This order is divided into several families, of which the Acrididæ or grasshoppers form one. Since the subdivisions or subfamilies are classed according to habits as well as structure, it might be well to mention them briefly, so that the casual observer may know from the insect in hand whether or not it is a highly injurious form.

One group, found more generally in low and marshy land, is characterized by a very receding front, forming a sharp angle at vertex of the head. This subfamily, *Tryxalinæ*, are not abundant enough to cause serious damage.

Common along the sides of roads and fields is a dusky grasshopper, showing as it flies a dark hind wing with white border. Frequently it pauses in the air, flitting its wings before alighting. This is the Carolina Locust (*Dissosteira Carolina*), or "dust-hopper," so called from its fondness for roadsides and dusty places. This familiar insect belongs to the subfamily *Œdipodinæ*, a group characterized by rough prominent ridge on crest of prothorax, the hood-shaped part immediately behind the head. While these are injurious at times, they do not, in this country, possess migratory instinct to any great extent.

The next group, the *Acridiinæ*, contains our most injurious forms. The prothorax is usually smooth on top, the breast between front legs usually extended into a tubercle. To this group belong those grasshoppers that migrate, and those that thrive well on cultivated crops in the locality of birth. The development of grasshoppers differs somewhat in detail, such as time and manner of depositing eggs.

LIFE HISTORY AND HABITS.

The life-history and habits of the Rocky Mountain Locust have been more fully worked out than any other, and we give it as typical, in part after Riley.

Where Eggs Are Laid.—The eggs may be laid in almost any kind of soil. The female prefers, however, bare sandy places, especially on high ground, not too compact, but moderately loose. We have watched the female spend 15 minutes in trying the consistency of the soil before finding a satisfactory place for oviposition. Crevices in the earth were not acceptable, though in two instances the abdomen was inserted well into the opening, only to be withdrawn to try elsewhere. Compact sandy soil, with south or east slope, is much preferred. The egg mass seldom reaches more than an inch below the surface. *M. spretus* chooses the soil. Instances are recorded where *M. differentialis* deposited eggs under bark of trees that had been felled on low land.

Manner in Which Eggs Are Laid.—When a suitable place is found, the female forces a hole in the ground by means of two pairs of horny-tipped appendages, which open and shut at the end of her abdomen, and from their peculiar structure are well adapted for the work. See plate V, fig. 10, *A*. With tips closed she pushes her abdomen into the ground, and by a series of muscular efforts and continued opening and closing of the two pairs of appendages she drills a hole, until nearly the whole abdomen is buried. The hole is more or less curved, and when completed she commences ovipositing. The eggs are bound together in a mass by a mucous fluid which at first

is soft, later becomes hard, is more or less impervious to water, and forms a very excellent protection. The number of eggs in a pod of *spretus* is from 25 to 30; in *M. differentialis*, from 100 to 150. It is thought that the former lays two or three pods of eggs during a season while the latter lays only one.

The casual observer might suppose the eggs were thrust promiscuously into the hole made for them. Not so; they are not only arranged to economize space, but to best facilitate the escape of the young. See plate V, fig. 10, *B*. The egg-laying season extends from six to eight weeks, though this period may be shortened or lengthened by climatic conditions, since the season is closed only by frost. The eggs will hatch in the order of being laid; so it is readily seen that all will not hatch at once. While the hatching period may cover six or eight weeks, and is also affected by climatic conditions, in this latitude Riley has found the bulk of them hatch about the last of April. As soon as hatched the young shed a covering or film, and begin at once to satisfy their renowned appetites. If sufficient food is at hand they are not noticed and cause little apprehension. If food is scarce they begin to hop, generally all in one direction, devouring everything before them.

The female is very intent upon her work of laying eggs and can be easily watched. At this season farmers will do well to observe their actions and the places where eggs are being laid, that intelligent action may be taken to prevent their hatching. See plate IV, fig. 8.

REMEDIES.

Natural.— The enemies of the locusts are many. Native birds and all domestic fowls feed with avidity upon them. Prairie-chickens and quails prefer them as food. It is safe to say that many birds not generally accredited aid in reducing the number of locusts. Professor Snow first ascertained that the Red-headed Woodpecker (*Melanerpes erythrocephalus*), Yellow-billed Cuckoo (*Coccyzus Americanus*), Cat-bird (*Galeoscoptes Carolinensis*), Red-eyed Vireo (*Vireo olivaceus*), Great-crested Flycatcher (*Myiarchus crinitus*), and Crow Blackbird (*Quiscalus quiscula aeneus*) feed upon the locust. Prof. Samuel Aughey has found by not less than 630 cases of dissection that 90 species of birds are partial to locusts as food. Many winter birds seek the egg-pods for food. Then let the preservation and multiplication of our native birds be given the thought and legislation they deserve.

Among quadrupeds the agriculturist find worthy allies. Hogs thrive upon the young locusts; cats spend the whole day in the field catching and eating them. Squirrels, chipmunks, weasels, and even

the odoriferous skunk, are recorded as rendering signal service in destroying this pest.

The locust finds, however, its most unrelenting enemies within its own class. Predacious beetles rummage the ground for egg-pods. The life-histories of several flies are prominently connected with that of the grasshopper. The larva or worm stage of several flies and beetles feeds upon numbers of eggs. The Red Locust Mite (*Trombidium locustarium*) early in the season attaches itself to the body or wing-pad of the locust, remaining there eating away the wings and sapping the strength of the locust until the mite is full grown, when it drops off and makes food of the locusts' eggs — a twofold enemy.

A tachinid fly, resembling somewhat the housefly, lights upon the back of the grasshopper while the wings are spread in flight and deposits an egg; this soon hatches as a whitish maggot. It works its way into the interior, feeding upon the vitals of the locust until the death of the 'hopper results.

Artificial Remedies. — Under this head crops as well as means must be considered. One of the problems is:

Alfalfa and the Grasshoppers.—A study of the habits of the grasshopper and the conditions of growth of alfalfa in the western half of the state reveals the fact that alfalfa is conducive to 'hoppers. The ground in an alfalfa field is characterized by its freedom from other smaller vegetation; as the farmer says, the alfalfa kills out other grasses and weeds, leaving many open bare places. The soil is sandy. Here we have the conditions for deposition of eggs — sandy soil, free from the interference of trash or fine rootlets.

When newly hatched, the young 'hopper, if forced to travel far before securing nourishing food, will perish. In the alfalfa field this risk is removed. The alfalfa, an early spring grower, furnishes him an invigorating meal upon his first appearance on earth, giving him strength from the moment of birth to hop away from pursuing foes.

Here are conditions highly favorable to preserve the "native" grasshoppers in destructive numbers. So clearly is this the case, that alfalfa promises well to become as noted as the home of the 'hopper, as wheat has been as the home of the chinch-bug. Conditions for his growth are good; conditions for his artificial destruction are equally good.

Alfalfa growers who have given it the test are unanimously of the opinion that "disking" the alfalfa ground in the autumn is highly beneficial to the crop, Mr. R. E. Edwards, of Kinsley, who has about 1,000 acres in alfalfa, hopes to be able to disk his whole tract. Mr. Geo. W. Watson, president of the Alfalfa Land and Irrigation Company, Kinsley, has large tracts of alfalfa which he will treat in the

same way. Mr. Watson has conversed with many prominent growers throughout southwestern Kansas, and finds them all in favor of disking for better growth of alfalfa. This being the case, here is an excellent opportunity for the "killing of two birds with one stone." The disk-harrow placed at a slight angle is bound to move the soil, disturb the egg-pod, and expose the eggs to the rain, sun, and action of frost. Upon this subject we take the following from the late Dr. C. V. Riley, then chief entomologist for the United States:

> Harrowing in the autumn, or during dry, mild weather in early winter, will prove one of the most effective modes of destroying the eggs and preventing future injury, wherever it is available. It should be enforced by law wherever the soil in any region is known to be abundantly stocked with eggs. A revolving harrow or cultivator will do excellent service in this way, not only in the field, but along roadways and other bare and uncultivated places. The object should be, not to stir deeply, but to scarify and pulverize as much as possible the soil to about the depth of an inch. Where the cultivator is used, it would be well to pass over the ground again with a drag or a brush harrow for this purpose.

Large areas are now given to the growth of alfalfa. As much as 400 or 500 acres of alfalfa can frequently be found in one plot. From such large and favorable breeding grounds it is possible for grasshoppers to come forth in myriads, devouring everything vegetable in the locality. If perchance the migratory Rocky Mountain Locust predominates, communities remote will suffer as severely.

Let the disk harrow be applied, and after it run the common harrow, with teeth slanted at right angles to the direction of the disk harrow, and the destruction of the eggs is assured. Fortunately the best time to do this is late in the fall, when the time of the farmer is not so urgently required in other lines.

General Remedies. — There are many ways in which farm practice may prevent injury from insects, and the intelligent farmer will become familiar with successful means of prevention as well as discriminate use of insecticides. He finds the possession of a good spraying pump, "hopper-dozer," necessary chemicals, and a thorough knowledge of their successful application, necessaries. He will have acquired sufficient literature pertaining to the subject to enable him to act immediately, not awaiting information while depredations are in rapid progress.

Natural enemies are always at work. In the case of the 'hopper, as well as many others, the destruction comes too late to benefit the farmer. Death from tachinid flies comes after the eggs are laid. When 'hoppers are plentiful, should their parasitic enemies and others destroy 50 per cent. of them, enough females would still remain to insure very appreciable injury the following year. Upon the farmer then rests the burden of protecting his crops.

Preventive remedies are harrowing and cross-harrowing land in the fall, where eggs have been laid. If ground is to be cultivated the following year, fall plowing is equally effective. Destructive means are: Where ground is smooth and crops small, crushing the young unfledged locusts with heavy roller. Where ground is rough and crops too high for rolling, the use of the "hopper-dozer," an illustration of which appears on plate V (fig. 12), with full directions for use.

Concerning the "hopper-dozer," Prof. Lawrence Bruner, of the University of Nebraska, but for this year employed by the government of the Argentine Republic to study, with a view to checking their ravages, the locusts of that country, says:

> By all odds the best method of destroying these insects is the use of the "hopper-dozer," or kerosene pan. This is made of stovepipe iron, by turning up the sides and ends about four inches, so as to make a long, flat pan about four inches in depth. This is then mounted on runners, varying in height according to requirements. On the frame back of the pan is stretched a piece of cloth to prevent the insects from jumping over the pan. When ready to begin work the pan is partially filled with water; then some coal-oil is added. The height of the runners will necessarily vary from 2 to 8 or 10 inches, according to crop to be protected and age of the insects to be captured. The machine may be of any length desired, up to 16 or 18 feet. When full, the insects can be removed, a little more oil added, and the machine again started. In this way a number of bushels of 'hoppers can be destroyed in a single day. The cost is trifling and the remedy effectual.

We have given the two most successful artificial remedies. Others are advocated, but have never been so successfully used. Bran poisoned with Paris green will be of value in protecting garden plats or small areas, but in large fields the "hopper-dozer" is universally proclaimed the most successful means of destruction.

DESCRIPTIONS.

The genus *Melanoplus* contains our most destructive forms in this state, and to this genus we will with one exception confine our descriptions.

THE ROCKY MOUNTAIN LOCUST.

(*Melanoplus spretus*, Thomas.)

The life-history has been given. With some variations this serves equally well for other species. The adult male measures about $1\frac{1}{8}$ inches, the female $1\frac{1}{4}$ inches, from head to tip of wing. The color of each is the same, a dirty olive and brown; front wings with row of dirty brown spots extending along middle from base to tip; hind wings transparent, with slight yellowish tinge at the base; tibiæ of hind legs vary in color from bright red to pale yellow, sometimes to bluish. The young resemble the adult except in wings. The very

young have no wings; later wing-pads appear, too short for flight; after last molt full wings are developed. This species distinguished from the common Red-legged Locust by longer wings, the wings extending one-third their length beyond tip of abdomen. In the male *spretus* the last joint of the abdomen turns up like the prow of a canoe and is notched, forming two tubercles at tip; while in the Red-legged Locust, *Melanoplus femur-rubrum*, the last joint of the abdomen turns up like the stern of a barge, is broad at top and not notched. See plate V, figure 11. Females of both species are distinguished by the four tips, the ovipositor, at the end of the abdomen.

Of all the destructive locusts of North America, this one has caused the greatest amount of damage and attracted the most public attention. The reports of the United States Entomological Commission, especially the second, contain full accounts of its life-history and habits.

This locust is a permanent resident of the Rocky mountain region, from northern New Mexico to northern limits of the prairies on the North Saskatchewan river. This range extends so as to include the greater portion of Wyoming, part of northwestern Nebraska, western part of South Dakota, half of North Dakota, and Manitoba, in British America. It is not always found in destructive numbers over this area, but always in a healthy condition. Adjoining this region is a strip about 100 miles wide called the "sub-permanent" region. Here it is nearly as healthy and about as abundant as upon the "permanent" range. Beyond this strip is a greater extent of country known as the "temporary" region. This region covers the remainder of the states named above, extends into Minnesota, Iowa, Missouri, Kansas, Arkansas, Indian territory, and Texas. This temporary region is occasionally visited by moving swarms, and consequently has suffered most from ravages of this locust during past years.

THE LESSER MIGRATORY LOCUST.

(*Melanoplus atlantis*, Riley.)

Next to *Melanoplus spretus* this is the most destructive of our North American locusts. It has occurred in destructive numbers in various parts of the interior, eastward but chiefly northward.

As the name implies, this locust is somewhat smaller than *spretus*. Though closely related, it is distinguished from *spretus* by its smaller size, darker and more marbled coloring; has proportionally shorter and narrower wings. It is migratory in habit, but to a less degree than *spretus*. It inhabits a much larger range than *spretus*, yet prefers hilly, wooded or mixed country to open prairies.

THE RED-LEGGED LOCUST.

(*Melanoplus femur-rubrum*, De Geer.)

Doubtless this is the most widely distributed insect of the family in America. It is found from ocean to ocean, from the extreme northern range of grasshoppers to Central America. High land and low land suit its taste equally well.

The chief differences between this locust and the Rocky Mountain Locust: In female, the wings of the Red-legged Locust are shorter than those of *spretus*. In the male, distinguishing characteristics are found in last joint of abdomen. (For full explanation, see plates, I, figures 1 and 2, V, fig. 11.) It differs in habits from the Lesser Migratory and Rocky Mountain Locusts in that it seldom exhibits the migratory trait. It sometimes collects in great swarms, but never rises to great heights, to be carried away by the winds. It is generally kept in check by natural enemies. "Hopper-dozers" are the effectual artificial remedy, even after the insect has acquired wings.

THE TWO-STRIPED LOCUST.

(*Melanoplus bivitatus*, Say.)

A common locust which occasionally becomes sufficiently numerous to cause great damage over limited areas. The male is about $1\frac{1}{4}$, the female $1\frac{1}{2}$ inches in length. In color the insect ranges from a dull green to a dull brown, and is characterized by a distinct yellowish or pale stripe extending on each side from the upper part of the eye to the end of the wing. See plate III, fig. 5. It is found over a large area, is not migratory, and by vigorous means at the right time can be kept from destroying crops.

THE DIFFERENTIAL LOCUST.

(*Melanoplus differentialis*, Thomas.)

Most conspicuous among the "native" locusts of Kansas is this Differential Locust. The tendency of civilization is to drive out the locust. This species, however, shows a tendency toward civilization. It is a little larger than the Two-striped Locust just mentioned, has no stripes along sides of back and wings, and is more yellowish throughout. See plate III, fig. 6. It frequents plowed fields; prefers corn, clover and alfalfa, etc., as well as garden products. The eggs are generally laid in cultivated grounds that are more or less compact, on old roads, or well-grazed pasture lands. Exceptions to this are found in case of eggs deposited under logs and bark of trees. Egg-laying season is from the middle of August until late in October. The range of this species is not so large as those previously named.

This species has only increased so as to be numerous enough for serious devastations since the settlement of its native soil. It was

this locust that caused the serious damage to alfalfa in the southwestern part of the state this year. Its large, robust body, with moderate wings, is not capable of long flight, but admirably adapted to destruction of crops. In alfalfa fields visited, many specimens were found much lighter yellow than the description given by Thomas of the insect. It attacks shade-trees, and in the gardens around Kinsley it showed a great fondness for cabbage, feeding upon the midveins after the leafy structure was taken. The "hopper-dozer" is effective even after the insect is full-fledged, since their flight is low and heavy.

LONG-WINGED LOCUST.

(*Dissosteira longipennis*, Thomas.)

Until recently this was classed among the comparatively harmless locusts. It is about two inches long; resembles our common "dust 'hoppers," so frequently flying up before us along the roadsides, except, instead of yellow fringe on hind wing, that portion of the Long-winged Locust is clear, transparent, with a few dark spots on tip of wing. See plate II, fig. 3.

It has caused considerable damage in eastern Colorado, but has not yet appeared in alarming numbers in Kansas.

It is well known that the complete destruction of the winged locusts, when they swarm down upon a country in such numbers as to darken the sun by their flight, is impossible. Man is powerless before the mighty host. Special plants or small areas may be partially protected by eternal vigilance in driving off or guarding by smudges, as locusts avoid smoke. His power then lies in the early stages of the insects' life, and prompt, intelligent action at that time. The remedies are not expensive; the means are effectual.

F. H. Snow, Ph. D.,
Professor of Entomology.

S. J. Hunter, M. A.,
Assistant Professor.

October, 1897.

EXPLANATION OF PLATES.*

Plate I.

FIGURE 1.—Rocky Mountain Locust, *Melanoplus spretus*, male, four times natural size.

FIGURE 2.—Red-legged Locust, *Melanoplus femur-rubrum*, male, four times natural size. For comparison of length of wings, spots on wings, and side view of abdomen, with *M. spretus*.

Plate II.

FIGURE 3.—Long-winged Locust, *Dissosteira longipennis*, female, natural size.

FIGURE 4.—Differential Locust, *Melanoplus differentialis*, female, natural size.

Plate III.

FIGURE 5.—Two-striped Locust, *Melanoplus bivitatus*, female, natural size.

FIGURE 6.—*a*, Differential Locust; *b*, Two-striped Locust; showing difference in markings when wings are folded.

Plate IV.

FIGURE 7.—Rocky Mountain Locust, *Melanoplus spretus*, female, natural size, with wings spread to show spots on fore-wing.

FIGURE 8.—Rocky Mountain locust; *a*, *a*, *a*, females laying eggs; *b*, egg-pod, with broken end, taken from ground; *c*, eggs, taken from pod; *d*, *e*, egg-pods in place below surface of ground; *f*, place where an egg-pod is buried.

FIGURE 9, *a*, *b*, *c*.—Stages in growth of young locust: *c* shows appearance of wing-pads.

Plate V.

FIGURE 10.—*A* shows ovipositors of female—*a*, in natural position; *b* and *c* show structure of tips used in digging. *B*, *a*, side view of egg-pod. Natural way of escape of young when hatched is in direction of arrows past *d*. If *d* is closed or obstructed, young can force their way directly to surface, as shown by dotted lines at *e*.

FIGURE 11.—*a*, side view, *b*, end view, tip of abdomen, showing tubercles, of Rocky Mountain Locust; *c*, side view, *d*, end view, of tip of abdomen of Red-legged Locust, showing broad structure like stern of a barge.

FIGURE 12.—"Hopper-dozer." See page 7 for instructions as to use.

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*Plate I, figures 1, 2, and plate V, figure 11, are from original drawings made by Miss Ella Weeks, under direction. Plate IV, figures 8, 9, and plate V, figures 10 and 12, are after Riley. The remaining figures are from original drawings made by Miss Mary Wellman, for "Common Injurious Insects of Kansas."

Plate I.

Fig. 1.

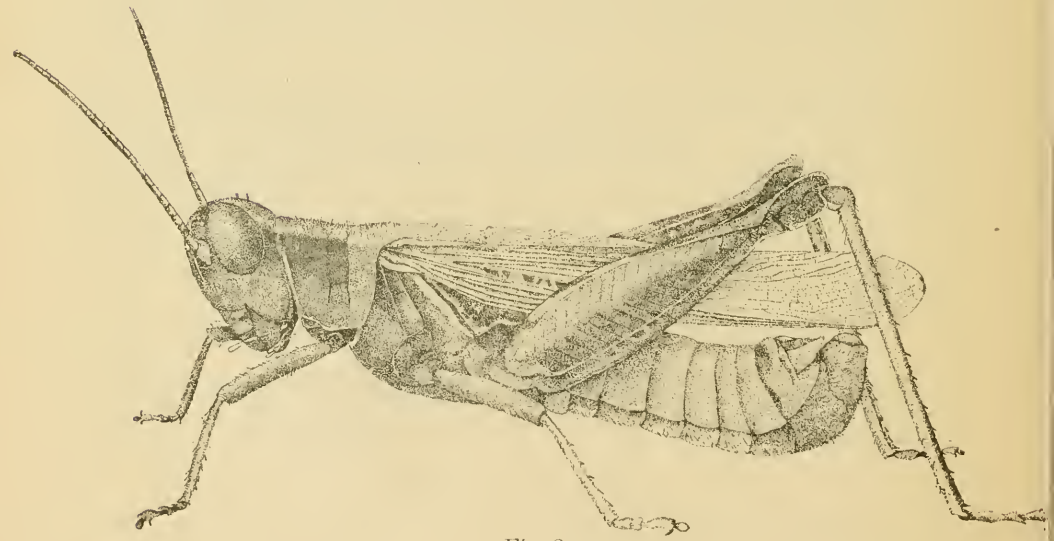

Fig. 2.

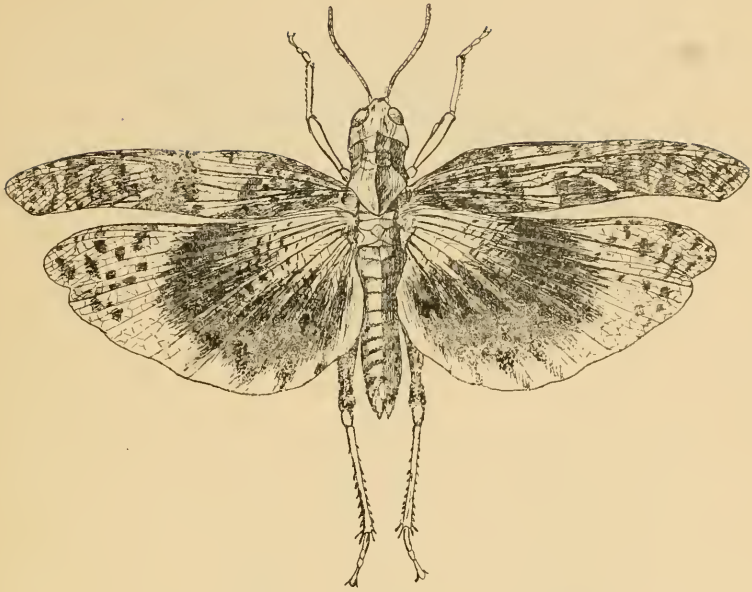

Fig. 3.

Fig. 4.

Plate III.

Fig. 5.

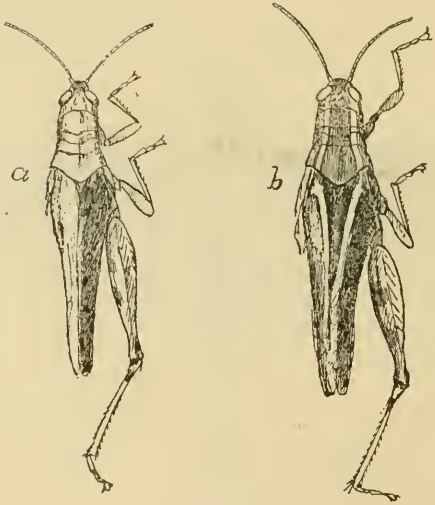

Fig. 6.

Plate IV.

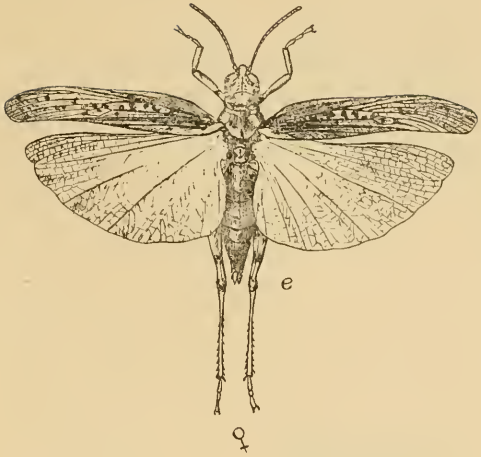

Fig. 7.

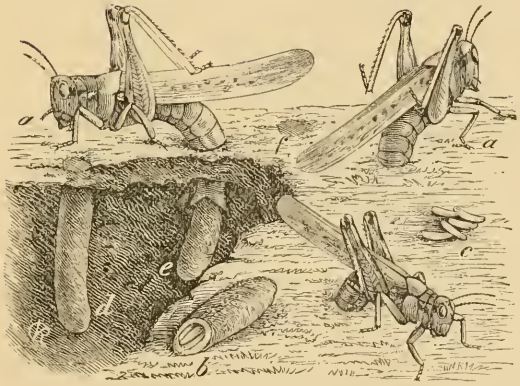

Fig. 8.

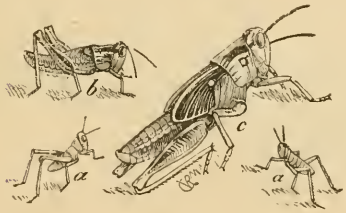

Fig. 9.

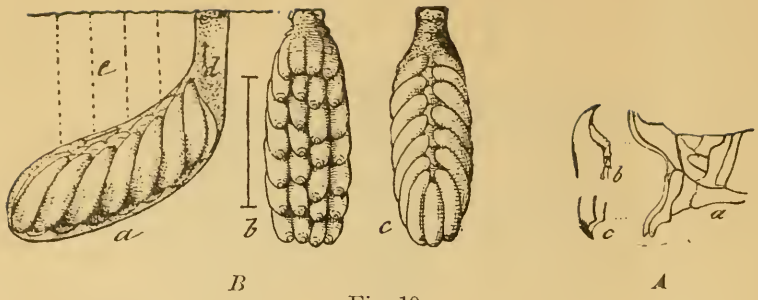

Fig. 10.

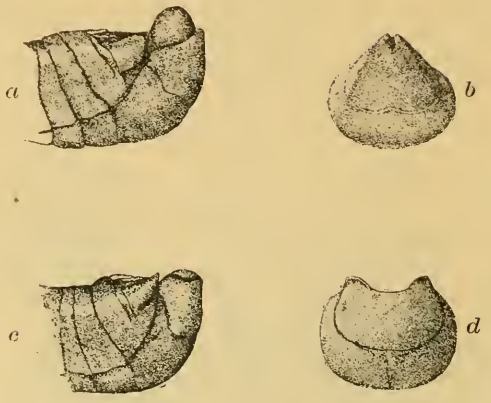

Fig. 11.

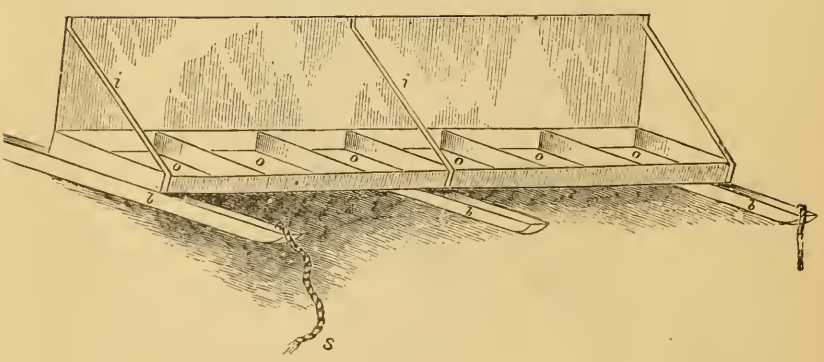

Fig. 12.

Syracuse, N. Y.
Stockton, Calif.

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Snow, Francis Huntington, 1840-1908.

The more destructive grasshoppers of Kansas.

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